

Contamination Threats to Drinking Water – Part I

NHDES Source Water Protection Program



STATE OF NEW HAMPSHIRE

Inter-Department Communication

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SUBJECT Identification of Contamination Threats to Drinking Water - Part 1

TO Source Water Protection Strategy Advisory Committee

As requested at the June 21st AdCom meeting, I am providing a review of the data from the Drinking Water Source Assessment Program (DWSAP), which examined each of the state's approximately 3,000 public water supply sources, mainly between 1999 and 2003. This memo summarizes the data with a view to identifying important categories of contamination threats to water supply sources. A subsequent memo will summarize data on the leading causes of known impacts to water supply sources.

The DWSAP looked at each source in terms of land uses that might affect water quality, as well as other factors such whether any contaminants (not including those typically of natural geologic origin) had been detected at the system in the previous round of routine monitoring.

While most factors (or threat categories) were rated High, Medium, or Low for each source, contaminant detects were rated either High (present at or above trigger levels) or Low (absent or below trigger levels). For each of the threat categories, Low generally means that the land use of concern was not found in the Wellhead Protection Area or near the well or intake, while Medium and High are associated with the presence of the land use and/or greater intensity and/or closer proximity to the well or intake. More detail is provided in the attached Explanatory Notes.

For this analysis, all sources were divided into High, Medium, and Low groups for each threat category, and each group was examined in terms of the percentage of sources receiving a High rating for contaminant detects (present at or above trigger levels). The results are summarized below. The results of the cross-tabulations are shown in the graph "Contaminant Detect Frequencies," which is attached along with the source data. Several threat categories are not included in the graph. Agricultural land cover is excluded because confidence in the accuracy of the agricultural land cover data is low. Potential contamination sources (PCSs) and Known contamination sources (KCSs) are shown in a separate graph (please see discussion following the summary). The number in parentheses following the name of each category is the number of non-transient public drinking water sources that received a High or Medium rating for that category.

Summary of DWSAP data on **Contaminant Detect Frequencies** in light of **Explanatory Notes** for SWAP vulnerability rankings (H-M-L):

- **Agricultural land (1,525 sources):** The accuracy of the agricultural land cover data is limited, casting doubt on the significance of this threat category, especially in light of the High group having a lower detect frequency than the Medium group.
- **Septic systems (1,447 sources):** It is far better (5% detects) to have no septic systems or sewer lines within 500 feet of the well than it is to have them there (17 – 18% detects).
- **Highways/railroads (1,137 sources):** It is much better (8% detects) to have no state highways or railroads in the Wellhead Protection Area than it is to have them there (15 – 16% detects).
- **Sanitary radius (940 sources):** It is better (15 – 16% detects) to have no sewers, septic systems, or regulated substances in the sanitary radius than it is to have them there (23% detects).
- **Potential Contamination Sources (833 sources):** It is better (12 – 14% detects) to have no PCSs within 1,000 feet of the well in the Wellhead Protection Area than it is to have 10 or fewer (17 – 20% detects), and it is better to have 10 or fewer than it is to have more than 10 (25 – 34% detects). The same is true whether or not you adjust for the risk of KCSs (see below).
- **Urban land cover (525 sources):** It is much better (13% detects) to have less than 10% urban land cover, especially within 1,000 feet of the well, than it is to have 10% urban land cover of more of the WHPA or HAC or the land within 1,000 feet of the well (25 - 26% detects).
- **Known Contamination Sources (KCSs – 449 sources):** It is better (14% detects) to have none in the WHPA than it is to have some (24 – 33% detects), and if they are in the WHPA, it is better to have them more than 1,000 feet from the well (33% vs. 24% detects).
- **Animals (164 sources):** It is much better (11% detects) not to have farms with 10 or more animal units within the WHPA than it is to have them (22 - 24% detects).
- **Well/intake (92 sources):** The difference in detect frequencies between the Low and High groups is not statistically significant ($p=0.52$).
- **Wastewater and septage lagoons (60 sources):** The differences in detect frequencies among the Low, Medium, and High groups is not statistically significant ($p=0.34$).

A note of caution is in order when interpreting these data: This is a fairly simple analysis and although the differences among the High, Medium, and Low groups are statistically significant except where noted, the analysis does not take into account the confounding effect that the risk of each land use may have on that of the others. For example, one might expect that where there are Known Contamination Sources (KCSs), there also tend to be Potential Contamination Sources (PCSs) nearby, and that the increased frequency of contaminant detects associated with PCSs is really attributable to the nearby KCSs. However, as shown in the graph, “Known and Potential Contamination Sources vs. Risk of Contamination,” this does not seem to be the case. As the third series of bars shows, even among wells where there are no KCSs in the WHPA, the frequency of contaminant detects increases with the number of PCSs near the well. This analysis has not been done for threat categories other than PCSs; therefore the possibility of confounding effects can not be ruled out on the basis of this analysis.

Attachments:

Contaminant Detect Frequencies by Threat Category and Rating (graph and tables)

Known and Potential Contamination Sources vs. Risk of Contamination (graph and text)

Explanatory Notes (regarding threat categories and ratings)

Contaminant Detect Frequencies by Threat Category and Rating

Source: NHDES Drinking Water Source Assessment Program, 1999 - 2003

Prepared by NHDES Source Water Protection Program 7/11/2007

Ag Land Cover	Detects	No Detects	Detects
H	108	584	16%
M	195	817	19%
L	38	259	13%

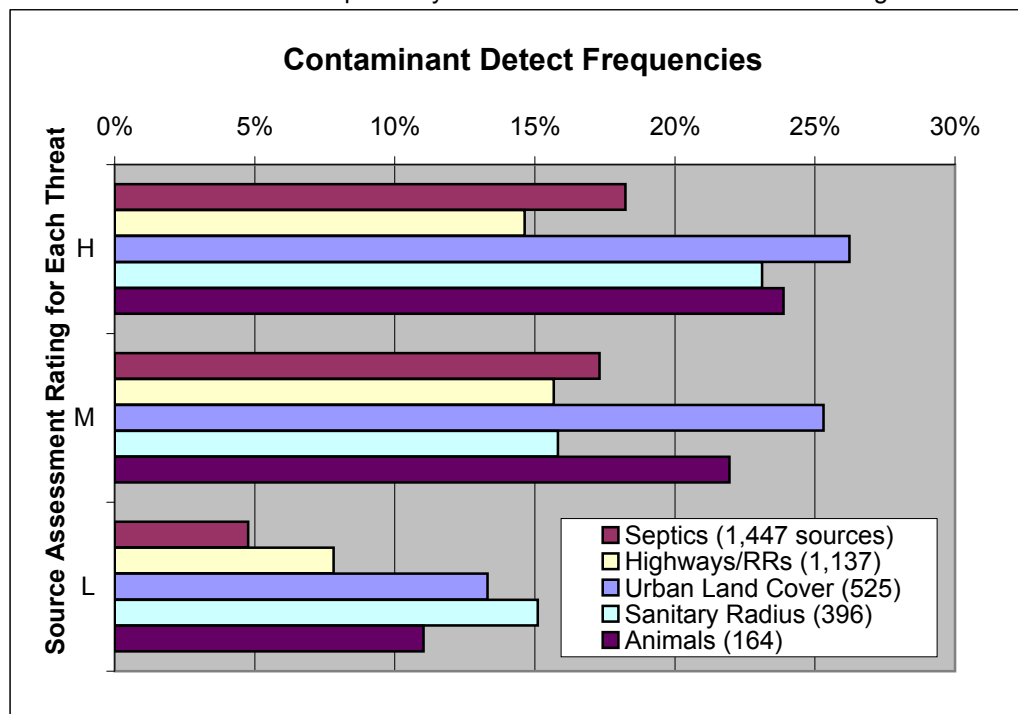
Septics	Detects	No Detects	Detects
H	190	852	18%
M	121	578	17%
L	71	1418	5%

Hwy/RR	Detects	No Detects	Detects
H	219	1277	15%
M	55	296	16%
L	108	1275	8%

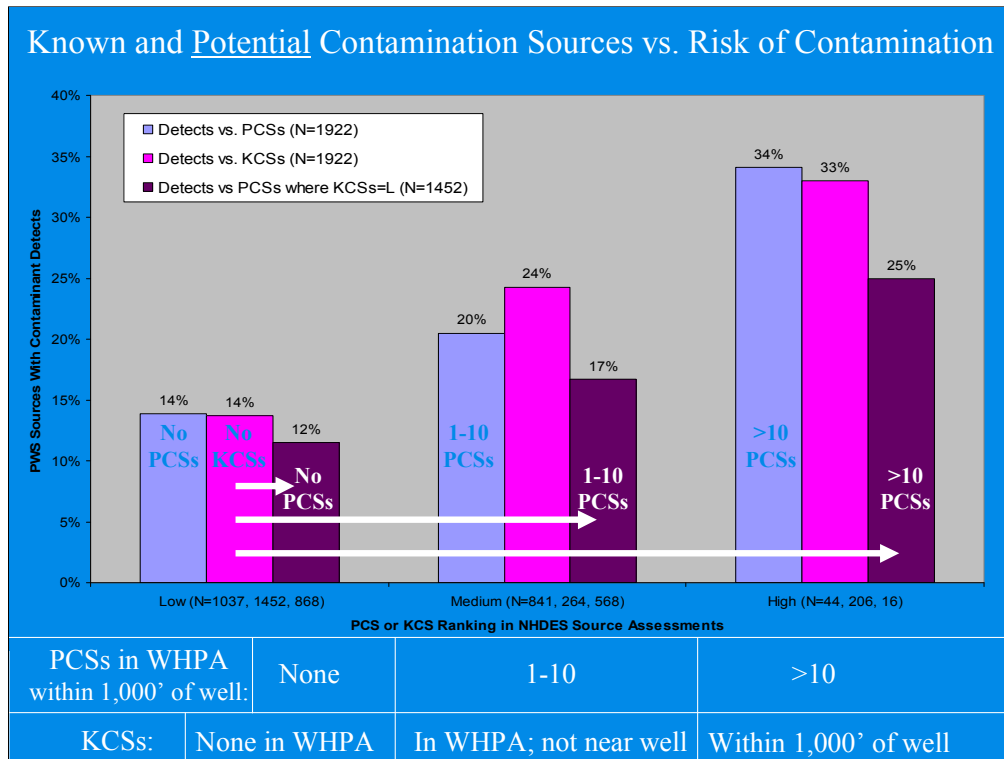
Sanitary Radius	Detects	No Detects	Detects
H	104	346	23%
M	97	516	16%
L	134	753	15%

Urban Land Cover	Detects	No Detects	Detects
H	112	315	26%
M	41	121	25%
L	188	1224	13%

Animals	Detects	No Detects	Detects
H	16	51	24%
M	27	96	22%
L	334	2695	11%



The graph shows the frequency of detections of anthropogenic contaminants as a function of the rating each group of sources received in the Drinking Water Source Assessment process. For example, of the sources with a Low rating for the presence of septic systems and sewer lines in the wellhead protection area, 5% had contaminant detections within the most recent round of monitoring. Numbers in parentheses are non-transient sources with elevated risk (Medium or High) except for Sanitary Radius, where elevated risk only includes High group.



First two series of bars are looking at detect rate as a function of PCS or KCS rating in Source Assessments. Table below chart describes the characteristics of each group (i.e., Low rating for PCSs means no PCSs in Wellhead Protection Area, while High means more than 10 PCSs).

Chi-square tests show that there are differences between the Low, Medium, and High groups in each series. But what if the sources with PCSs also tend to have KCSs? Maybe the risk that appears to be from PCSs is really from KCSs. To test that theory, look at last series: 1452 systems with no KCSs. They still show increased risk of detects associated with PCSs within 1,000 ft. of well. ($p < 0.01$)

Abbreviations used in the following notes:

HAC = hydrologic area of concern for a surface water source. *For small or undeveloped watersheds, the HAC includes the entire watershed. For all other surface sources, the HAC includes only a portion of the watershed close to the water system intake.*

WHPA = wellhead protection area for a groundwater source. *For community and non-transient systems, the WHPA is the area from which water is expected to flow to the well under extremely dry conditions. For transient systems, the WHPA is the area within 500 ft of the well.*

EPAID: Each public water system is identified by a 7-digit federal ID number.

Source number: Each source is further identified by a 3-digit number.

Source description: An abbreviated description of the source from NHDES's database. (Some common abbreviations: BRW=bedrock well; GPW=gravel-pack well; GRW=gravel well; DUG=dug well; PTW=point well; SPR=spring; ART=artesian well; INF=infiltration well.)

Source type: G=groundwater (well or spring); S=surface water (lakes, reservoirs, ponds, rivers); E = water purchased from another system (*Purchased sources are not assessed per se, but the original sources used by the seller are assessed*).

Date Assessment Completed: The date NHDES completed the process of reviewing available data, collecting new data, and entered the assessment information into its database.

Number of Vulnerability Rankings: The number of High, Medium, and Low rankings for that source listed in the columns to the right. Each criterion is explained below. Some criteria do not apply to all types of sources or systems.

Detects: Confirmed detections of certain contaminants (after treatment) of suspected human origin, not including disinfection byproducts. L = none detected at or above trigger levels in the most recent round of sampling. There is no M ranking for this criterion. H = contaminants were detected at or above trigger levels.

Well/Intake: The integrity of the well (if a groundwater source) or the intake (if a surface water source). L = no unresolved deficiencies with the well or intake identified in the most recent sanitary survey. There is no M ranking for this criterion. H = there are unresolved deficiencies.

KCSs: Known contamination sources in the vicinity of the source. This includes any site known to DES where contaminants are known or very likely to have been released to the ground, and where remediation is not complete. L = none present in the WHPA (for groundwater sources) or in the HAC (for surface water sources). M (for community and non-transient systems) = one or more KCSs in the WHPA or HAC but not within 1,000 ft of the well or intake. *There is no M ranking for transient systems.* H = one or more KCSs within the WHPA or HAC within 1,000 ft of the well or intake.

PCSs: Potential contamination sources in the vicinity of the source. This includes any site known to DES where contaminants are known or very likely to be used in significant quantities, but where there are no known releases to the ground. L (for community and non-transient systems) = no PCSs within 1,000 ft of the well in the WHPA (for groundwater sources) or none present in the HAC (for surface water sources). L (for transient systems) = none present in the WHPA. M (for groundwater sources serving community and non-transient systems) = 10 or fewer PCSs within 1,000 ft of the well in the WHPA. M (for surface water sources) = one or more PCSs in the HAC but not within

1,000 ft of the intake. *There is no M ranking for transient systems.* H (for groundwater sources serving community and non-transient systems) = more than 10 PCSs within 1,000 ft of the well in the WHPA. H (for transient sources) = one or more PCSs in the WHPA. H (for surface water sources) = one or more within 1,000 ft of the intake in the HAC.

Highways/RRs: The presence of numbered state highways or active railroads in the vicinity of the source. L = none present in the WHPA or HAC. M (for community and non-transient groundwater sources) = one or more in the WHPA but not within 1,000 ft of the well. M (for surface sources) = one or more in the HAC but not within 300 ft of the source water. *There is no M ranking for transient systems.* H (for transient sources) = one or more in the WHPA. H (for community and non-transient groundwater sources) = one or more in the WHPA within 1,000 ft of the well. H (for surface sources) = one or more in the HAC within 300 ft of the source water.

Pesticides: Whether or not pesticides have been routinely applied in the vicinity of the source. This is based on the presence of land parcels owned by registered pesticide applicators. L = no application areas in WHPA or HAC. M (for community and non-transient sources) = application site(s) in WHPA or HAC but not within 500 ft of the well or within 300 ft of the intake. *There is no M ranking for transient systems.* H = application site(s) within 500 ft of the well or within 300 ft of the intake.

Septics: The presence or density of septic systems and sewer lines in the vicinity of the source. L (for community and non-transient groundwater sources) = no septic systems or sewer lines located within 500 ft of the well, and fewer than 30 septic systems in the remainder of the WHPA. L (for surface sources) = no septic systems within 500 ft of surface water. L (for transient sources) = no septic systems or sewer lines within 75 ft of the well. M (for community and non-transient groundwater sources) = fewer than 10 septic systems and no sewer line located within 500 ft of well, and fewer than 30 septic systems in remainder of the WHPA. M (for surface sources) = low density of septic systems (lots averaging 2 acres or more) within 500 ft of surface water in the HAC. *There is no M ranking for transient systems.* H (for community and non-transient groundwater sources) = 10 or more septic systems or any sewer line within 500 ft of the well and/or high density of septic systems (more than 30) in the WHPA. H (for surface sources) = densely developed shoreline (lots averaging less than 2 acres) within 500 ft of surface water in the HAC. H (for transient sources) = one or more septic systems or sewer lines within 75 ft of the well.

Urban Land Cover: The percentage of urban land cover in the vicinity of the source, based primarily on satellite images. *This criterion does not apply to sources serving transient systems.* L = less than 10% of the WHPA or HAC is urban, and less than 10% of the WHPA within 1,000 ft of the well is urban. M (for community and non-transient groundwater sources) = less than 10% of WHPA is urban but 10% or more of the WHPA within 1,000 ft of the well is urban. M (for surface sources) = between 10% and 20% of HAC is urban. H (for community and non-transient groundwater sources) = 10% or more of WHPA is urban. H (for surface sources) = 20% or more of HAC is urban.

Ag Land Cover: The percentage of agricultural land cover in the vicinity of the source (in the WHPA or within 300 ft of surface water in the HAC), based primarily on satellite images. *This criterion does not apply to sources serving transient systems.* L = no ag land. M = less than 10% ag land. H = 10% or more ag land.

Animals: The presence of concentrations of 10 or more animal units in the vicinity of the source. L = none in the WHPA or (for a surface source) within 300 ft of surface water in the watershed. M (for community and non-transient groundwater sources) = one or more such farms in the WHPA but not within 1,000 ft of the well. M (for a surface source) = none within 300 ft of surface water in the HAC, but one or more

within 300 ft of surface water in the watershed. *There is no M ranking for transient systems.* H = one or more in the WHPA within 1,000 ft of the well or (for a surface source) within 300 ft of surface water in the HAC.

Lagoons: The presence of wastewater treatment lagoons or spray irrigation sites in the vicinity of the source. L = none in the WHPA or (for a surface source) in the entire watershed. M (for community and non-transient groundwater sources) = one or more in the WHPA but not within 1,000 ft of the well. M (for a surface source) = none within 300 ft of surface water in the HAC, but one or more in the watershed. *There is no M ranking for transient systems.* H = one or more in the WHPA within 1,000 ft of the well or (for a surface source) within 300 ft of surface water in the HAC.

Dry Discharge: The presence of dry-weather stormwater discharge sites in the vicinity of the source. *Only a handful of surface sources were evaluated for such discharges; no discharges were found.*

Sanitary Radius: The presence of development not associated with the well within the sanitary radius (within 75 to 400 ft of the well). *Applies only to groundwater sources serving community and non-transient systems.* Of particular concern are sewer lines, septic systems, or storage of regulated substances in this area. L = no inappropriate land uses or practices. M = no sewers, septic systems, or regulated substances. H = inappropriate land uses or practices were discovered during the most recent sanitary survey, and have not been corrected.

Trophic status: The projected trophic (nutrient) status of the source as predicted by a computer model using a future land development scenario for the watershed. *This criterion applies only to 24 lakes, ponds, and reservoirs included in the phosphorus loading study.* L = oligotrophic (relatively good clarity and water quality with low algae population). M = mesotrophic (intermediate clarity, quality, and algae population). H = eutrophic (relatively low clarity and high algae population).